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Influence of organic manures with recommended inorganic fertilizers on yield of sweet orange (Bari malta 1)

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ABSTRACT

The experiment was carried out at the research orchard of Horticulture Research Centre, Regional Agricultural Research Station, Hathazari, Chittagong to determine the influence of organic manure with the recommended inorganic fertilizers on the growth and yield of BARI Malta 1. Six treatments, i. e., consisting of organic manures along with recommended inorganic fertilizers, were used. Results revealed that application of mixed organic manure consisting of 10kg cowdung with 10kg poultry manure or 1 kg mustered oilcake with recommended fertilizers significantly influenced the fruit bearing and yield of fruits and produced 100% and 87% higher yield than only cowdung with recommended inorganic fertilizer and recommended inorganic fertilizers alone. This treatment also showed better plant growth and quality fruit production as indicated by plant height, canopy spread and the highest TSS content (8%) in the harvested fruits.

Keywords: Sweet orange, Citrus, Organic manure and Inorganic fertilizer

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I. Introduction

Citrus fruits play an important role in the fruit world for its availability period and high market price. In Bangladesh, there are a good number of citrus species in hilly areas which certainly can contribute to nutritional demand. Sweet orange is one of the most important citrus fruits in our country. Bangladesh Agricultural Research Institute has developed a sweet orange variety named BARI Malta 1. It is the good source of vitamin C and minerals as well as people preferred it because of its sweet and sour test & pleasant flavor. That is why, it is gaining popularity day by day. Nowadays, it is commercially grown in Sylhet and Chittagong hill tracts region because of its countrywide high demand. Judicious application of organic and inorganic fertilizers is very important for sustainable and quality yield of sweet orange. Fertilizers are required to support adequate mineral nutrition of citrus

and to ensure high crop productivity in low fertility tropical and sub-tropical soils. Plant growth, fruit yield and quality of citrus trees depends largely on nitrogen (N) and potassium (K) fertilization (Cantarella *et al.*, 2003; Alva *et al.*, 2006), elements which represent the greatest quantity of nutrients exported through harvest (Bataglia *et al.*, 1977; Mattos Jr. *et al.*, 2003). Koo and Reese (1972) evaluated the effect of K sources on yield and quality of citrus fruits. The main purpose of organic and inorganic fertilizers is to restore tree vigor after fruit production. At the same time, growers may improve the condition of the soil by applying organic manure and/or liming materials. If organic fertilizer is used by growers should use cowdung or some other organic fertilizer with a nitrogen content of more than 5%. The approximate application rate should be 10-15 kg per tree. If this is done, the amount of applied chemical fertilizer can be reduced by 350 to 500 g per tree. When organic fertilizers with lower nitrogen content are used, such as composted oilcake manure, the application rate should be at least 30 - 60 kg per tree. Among the different strategies able to guarantee an adequate input of organic matter to soil, organic fertilization like composts obtained from organic manures of different origin (i.e. poultry refuse, intensive livestock, mustard oilcake) and characterized by stabilized organic matter (Tittarelli and Canali 2002). Organic manuring is often considered as a sustainable agricultural practice, and if used appropriately, promises to offer rich dividends on a long-term basis (Ferguson, 1990). Citrus growers apply organic materials for perceived or real improvements in soil physical, chemical and biological properties, but the main benefits appear to be the increased nutrient availability (Obreza and Ozores-Hampton 2000). Like any other fruit trees, citrus requires 16 essential elements for normal growth, production quality irrespective of source (Zekri, 1995), over this is spread a layer of organic manures and they are both then covered with topsoil. Despite the importance of organic manure and inorganic fertilization, literatures in relation to the influence of organic and inorganic fertilization on the yield and quality of BARI Malta 1 are very scarce under Bangladesh condition. Thus present study is designed to standardize organic manuring with inorganic fertilizers dose for BARI Malta1.

II. Materials and Methods

The experiment was carried out at the research orchard of Horticulture Research Centre, Regional Agricultural Research Station, Hathazari, Chittagong from February to October, 2015. The soil was clay loam in texture with medium organic matter. The experiment was laid out in a RCB design with 6 replications and maintaining 3m x 3m spacing. There were 7 treatments including control T₇ (RD= Recommended dose: N @ 240g, P @ 120g, K @ 120 g, S @ 30 g, Zn @ 10g and B @ 2g per plant). Treatment one (T₁) consisted with cowdung 10kg/plant + RD (chemical fertilizer); treatment two (T₂) comprised with cowdung 15kg/plant + RD (chemical fertilizer); treatment three (T₃) accomplished with cowdung 10kg/plant + poultry manure @ 10kg + RD (chemical fertilizer); treatment four (T₄) was cowdung 15kg/plant + poultry manure @ 15kg + RD (chemical fertilizer); treatment five (T₅) consisted with cowdung 10kg/plant + Mustard oil cake @1kg + RD (chemical fertilizer); treatment six (T₆) accomplished with cowdung 15kg/plant + Mustard oil cake @2kg + RD (chemical fertilizer) per plant. All the recommended fertilizer doses were applied in three equal splits during March, May and October (just after harvesting of fruits). Fertilizers should be applied around the tree up to the canopy spread leaving 50-100 cm from the tree base and mixed gently with the soil followed by irrigation. Under hill condition, dibbling method was followed. Data were recorded on plant age, plant height, bearing duration, canopy spread (East-West/North-South), number of fruits per plant, marketable yield per plant, marketable yield per hectare, fruit length, fruit diameter, rind weight, percentage of edible portion and TSS. Analysis of variance (ANOVA) and mean separation of treatments were done using LSD in R software.

III. Results and Discussion

Results of the present experiment consisting of the growth, fruit characteristics and the yield of BARI Malta 1 are presented in the Table 01 and 02 and Figure 01 and 02 respectively. Considering the growth parameters, plant height and canopy spread showed no significant differences among the treatments indicating that there was no influence of organic fertilizers in expressing the plant height and the canopy spread. The maximum plant height (2.8m) was recorded in the plants under treatment T₁ followed by recommended fertilizer T₇ (2.7m). Vegetative growth of plants is accelerated by application of nitrogenous fertilizers (Alva *et al.*, 2006). Application of organic manures (cowdung, poultry manure and mustard oilcake) usually released nitrogen very slowly and steadily through

decomposition and take longer time (Tittarelli and Canali, 2002), which may not influenced the vegetative growth of sweet orange plants under the different treatments. In the present experiment, the plant height and canopy spread attained by the plants in different treatments might be due to the effect of recommended inorganic fertilizers (nitrogenous) which was equal to the all treatments. The maximum number of marketable fruits per plant (42) was recorded in the plants (T₅) treated with 10kg cowdung and 1kg mustard oilcake followed by (T₃), i. e., 10kg cowdung and 10kg poultry manure (39) and T₆ (37). The lowest number of fruits per plant (21) was recorded from the plants under T₇ i.e. recommended inorganic fertilizers. The results revealed that fruit bearing in the plants treated with 10kg cowdung with 1kg mustard oilcake as well as 10kg cowdung with 10kg poultry manure were significantly higher than other treatments. Treatments T₇ (recommended dose) and T₁ (recommended dose with 10kg cowdung) showed the lowest fruit bearing indicating that the application of organic manures in the form of cowdung with mustard oilcake or decomposed poultry manure showed significantly positive influence of fruit bearing of BARI Malta 1.

Table 01. Growth parameters of different treatments of BARI Malta 1

Treatment	Plant age (years)	Plant height (m)	Bearing duration (month)	Canopy spread	
				East-West (m)	North-South (m)
T1	9	2.8	9	2.13	2.15
T2	9	2.3	9	1.96	1.92
T3	9	2.3	9	2.15	1.92
T4	9	2.4	9	1.98	1.33
T5	9	2.3	9	1.82	1.81
T6	9	2.1	9	1.66	1.82
T7	9	2.7	9	2.00	1.73
<i>Lev. of Sig</i>	<i>ns</i>	<i>ns</i>	<i>ns</i>	<i>ns</i>	<i>ns</i>
<i>LSD</i>	4.2	0.66	4.2	0.59	0.57
<i>CV (%)</i>	3.9	23.3	3.9	25.7	24.9

Generally in the early stage of fruit development BARI Malta 1 bears huge number of fruits. As the fruits grow in size (bigger), the requirement of nutrients for each fruit increased and supplementary supply of nutrient elements to the plants becomes helpful for proper growth, development and better fruit retention per plant. In this study, the treatments with cowdung and mustered oilcake or with poultry manure might ensure the continuous supply of the required nutrient elements to the fruits resulting higher fruit retention of plants as well as bigger size of fruits.

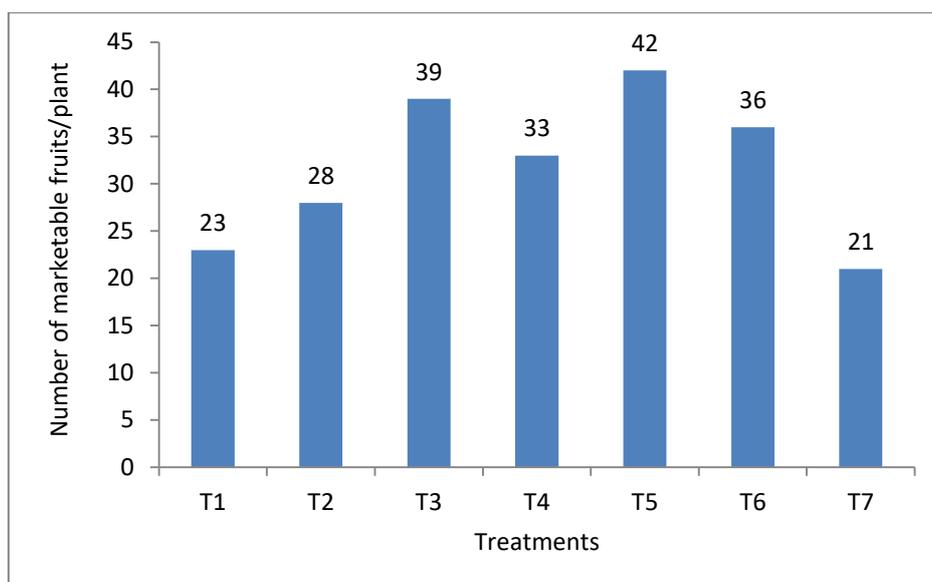


Figure 01. Number of marketable fruits per plant.

The fruit length and fruit diameter showed no significant influence with the application of organic manure. However, maximum fruit length (5.7cm) and diameter (5.6cm) was recorded in T₃ & T₄ i.e. when cowdung and poultry manure applied with recommended fertilizers and with these treatments

full potentials of the fruit size (length and diameter) was expressed. The percentage of edible portion ranged from 74.5-76 %, which was the maximum expression of the edible portion of different sweet orange variety and were not varied with the applied treatments. The TSS % showed an increased with the increased amount and different kinds of organic manure (cowdung, poultry manure and mustard oilcake) along with the recommended inorganic fertilizers. The yield of sweet orange per plant showed significant influence with the addition of organic manure along with recommended inorganic fertilizers. The highest per plant yield (3.6kg/plant) was recorded in the treatment T₃ followed by T₅ (3.3kg/plant) and the lowest yield recorded in the treatment T₁ comprises with 10kg cowdung with recommended inorganic fertilizers. The yield per plant of sweet orange produced by this treatment is statistically lowest as per with the treatments T₂ and T₇ and significantly lower than those of other treatments.

Table 02. Yield and yield contributing characters of different treatments of BARI Malta 1

Treatment	Yield (kg/Plant)	Fruit length (cm)	Fruit diameter (cm)	Rind weight (g)	Edible portion (%)	TSS (%)
T1	1.8	5.3	5.3	19.3	76.1	7.5
T2	2.5	5.6	5.5	21.8	75.4	6.5
T3	3.6	5.6	5.6	23.7	74.5	8.0
T4	2.8	5.7	5.6	20.8	75.7	7.0
T5	3.3	5.3	5.3	18.8	76.0	8.0
T6	2.9	5.2	5.4	20.0	75.0	7.0
T7	1.9	5.6	5.5	22.6	74.9	8.0
<i>Lev. of Sig</i>	***	ns	ns	ns	ns	-
<i>LSD</i>	0.85	0.47	0.39	4.2	4.9	-
<i>CV (%)</i>	26.7	7.3	6.0	16.8	5.5	-

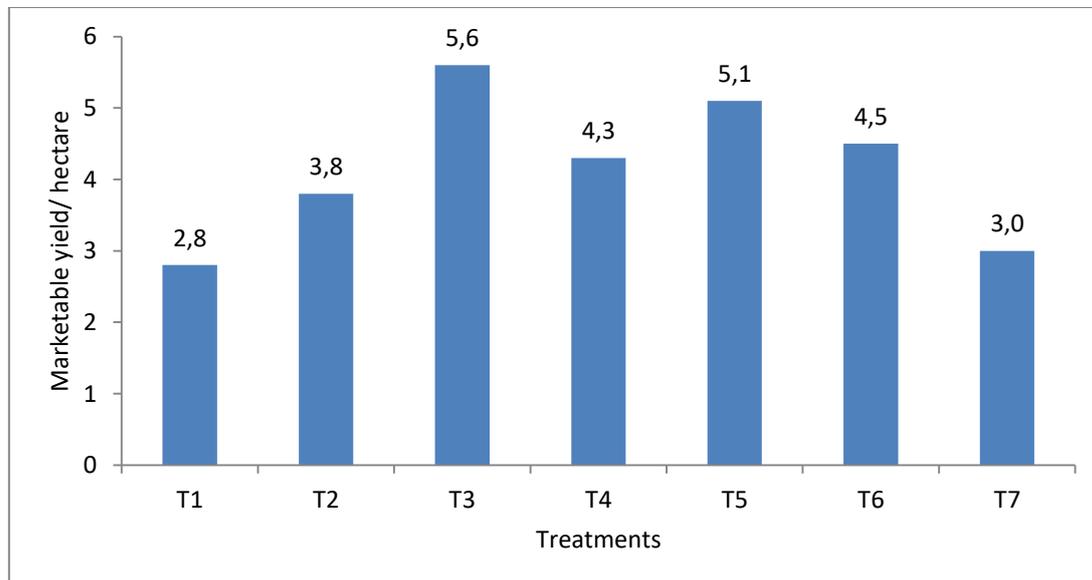


Figure 02. Marketable fruit yield per hectare.

Results revealed that the treatments consisting of the mixed organic manures, i. e., cowdung with poultry manure or mustard oilcake along with recommended inorganic fertilizers produced significantly higher yield than the treatments consisting of only cowdung with recommended inorganic fertilizers. Generally, fruit growth and development depends on the sufficient and continuous supply of all the nutrient elements. The treatments T₃, T₄, T₅ and T₆ consisted of the mixed organic manure, i.e., cowdung, mustard oilcake or poultry manure might facilitate the sufficient and continuous supply of nitrogen and other nutrient elements for proper growth, development and fruit retention of plants resulting the higher yield in these treatments. The results of the present experiment were in agreement with [Alva et al. \(2006\)](#) and [Cantarella et al. \(2003\)](#). The highest

marketable yield (5.6 t/ha) was recorded in T₃ treatment followed by T₅ (5.1 t/ha), T₆ (4.5 t/ha), T₄ (4.3 t/ha) which were significantly higher than those of T₇, T₁ and T₂ treatments. The highest marketable fruit yield obtained in T₃ treatment was 100 % higher than the lowest yielder T₁ treatment and 87% higher yield than the treatment confining only the recommended inorganic fertilizers.

IV. Conclusion

Application of mixed organic manures consisting of 10kg cowdung and 1kg mustard oilcake or 10kg poultry manure along with recommended inorganic fertilizers showed the best performance in producing higher yield and quality of BARI Malta 1 rather than the alone recommended inorganic fertilizers or only cowdung with recommended inorganic fertilizers. Therefore, for better yield and quality production of BARI Malta 1 mixed organic manure consisting of cowdung and mustard oilcake or poultry manure along with recommended inorganic fertilizers could be suggested. These results should be repeated for several years before final precise recommendation.

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